

EUROPEAN PATENT APPLICATION

Application number: 88109832.1

Int. Cl.⁴: B04B 5/04

Date of filing: 21.06.88

Priority: 01.07.87 US 68461

Date of publication of application:
04.01.89 Bulletin 89/01

Designated Contracting States:
CH DE ES FR GB IT LI NL SE

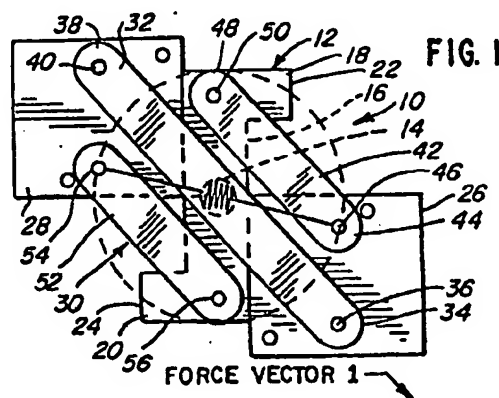
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Fluid separation and processing device.

An assembly (10) for separating, metering and delivering fluids includes a central rotating member (12) rotatable about a fixed spin axis (14). A processing chamber holding member is connected to the central rotating member (12) by a centrifugally actuated frame (30). At rotational speeds below a first predetermined speed, the centrifugally actuated frame (30) is in a first position. At rotational speeds greater than the first speed, centrifugal force moves the frame (30) to a second position angularly spaced from and at greater distance from the spin axis (14) than the first position. A processing chamber (60) is mounted on the holding member (28, 28) and its orientation relative to the spin axis (14) is the same in the first and second positions. Fluid is provided in the processing chamber (60). By accelerating the processing chamber (60) to the first predetermined speed and decelerating below the first predetermined speed in a selected sequence, specific centrifugal force vectors are generated in the processing chamber (60) that move the fluid (70) and retain it in selected chambers (80, 98, 104, 120). During this sequence, the fluid (70) is metered, separated and delivered to a reduction area (138) where measuring is performed.



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FLUID SEPARATION AND PROCESSING DEVICE

BACKGROUND OF THE INVENTIONA. Field Of The Invention

The present invention relates to fluid separation devices and planchettes or processing chambers therefor, and more particularly, the present invention relates to a centrifugally actuated device that can apply different centrifuge force vectors on the planchette to control fluid flow within the planchette. The invention is particularly applicable to the processing of whole blood.

B. Description of the Background Art

Analysis of fluids is required in a wide variety of instances. One common analysis is to determine blood chemistries. This analysis involves obtaining a sample of blood from a patient and centrifuging the blood sample to separate solid components such as, for example, red blood cells from the liquid component of the blood sample. Upon separating the liquid component, it is metered, diluted with a buffer solution and applied to a reagent for measuring. This analysis requires a number of time consuming, manual steps and the use of elaborate and complex instrumentation.

Manual analyses require obtaining a blood sample and placing it into a centrifuge device to obtain liquid separation from the solid components. The liquid is then manually removed and transferred to a container for dilution and/or mixing with reagents. Once mixing has occurred, an instrument is used to measure the different components in the sample. In an attempt to eliminate these manual steps, several instruments have been developed that use centrifugal force to perform the various analyses while minimizing the need for manual manipulation. One such instrument is disclosed in European patent application 160,901, filed April 28, 1985. This application discloses an apparatus for generating centrifugal force and includes a plate rotatable about an axis with at least one holding device mounted on the plate. The holding device is adapted to receive a processing card or planchette. The apparatus includes structure for rotating the planchette relative to the plate member during spinning of the plate member thereby changing the portion of the processing card acted on by the centrifugal force. In this apparatus, the planchette

or processing card remains in the same location relative to the plate member; however, the processing card or planchette is rotated such that different sides or ends of the planchette are acted on by the centrifugal force vector.

The apparatus described in European Patent Application No. 160,901 requires complex mechanical structure and related equipment in order to accomplish the rotation of the planchette or processing card during spinning of the plate. The complexity of the mechanical structure required increases the expense of the apparatus and servicing of the apparatus is expensive and difficult. Moreover, the apparatus is very sensitive to balancing since if it is slightly out of balance, the vibration can damage or destroy the complex mechanical structure.

In centrifugal analysis devices of the type described, the processing card or planchette is also very important. An example of a processing card or planchette is provided in European patent application 160,282, filed April 28, 1985. This application discloses a sample processing card or planchette that is to be used with a centrifuge device. The processor card or planchette includes a supply of chemical reagent and inlet means for supplying a chemical sample such as whole blood into the processing card. The chemical sample is moved by centrifugal force through different passages and chambers in the processing card and is mixed with a reagent allowing a chemical analysis to be performed.

The disclosed processing card or planchette requires overflow chambers and cavities to provide the desired measured amount of fluid. This processing card relies on a true fill and emptying process wherein the different chambers and cavities are filled and the processing card is physically rotated to empty fluid out of the different chambers and cavities. Physical barriers in the form of walls partially extending into openings in the chamber are necessary to prevent the emptying of separated material out of the cavities when the processing card is rotated. For example, whole blood may be centrifuged in one of the cavities. The processing card is then rotated relative to a plate of the centrifuge to pour plasma out of the cavity while the solid red blood cells are held in the cavity by a barrier wall at the mouth of the cavity. Since the cavities are physically filled or emptied in accordance with this process, the location of the processing card relative to the spin axis of the centrifuge device is not critical.

It is desirable to provide an apparatus for performing chemical analyses using centrifugal force